



FOURTEENTH AIR NAVIGATION CONFERENCE

Montreal, Canada, 26 August to 6 September 2024

Agenda Item 4: Hyper-connectivity of air navigation system

4.1: Connected aircraft concept and associated challenges

5G C-BAND INTERFERENCE TO RADIO ALTIMETER OPERATIONS

(Presented by the United States)

EXECUTIVE SUMMARY

Global deployment of 5G wireless in the C-Band continues close to the aircraft radio altimeter band (4.2 – 4.4 GHz). United States registered commercial aircraft and foreign commercial aircraft that fly into the United States recently completed a retrofit to existing radio altimeters to ensure safe coexistence with 5G C-Band emissions in the United States. However, this retrofit was a short-term mitigation to allow near-full deployment of wireless networks transmitting under a voluntary agreement to adhere to several conditions to minimize the impact on aviation. Many States' civil aviation authorities (CAAs) and telecom regulating agencies are developing coexistence strategies for their unique deployment characteristics.

RTCA and European Organisation for Civil Aviation Equipment (EUROCAE) are working on updated minimum operational performance standards for the radio altimeter. Their goal is to develop interference tolerance standards, using state-of-the-art avionics designs, to improve the robustness of future radio altimeters to existing and planned in-band and out-of-band interference; however, the new standards may not resolve all possible interference effects from current and future deployments near the radio altimeter band.

Another challenge is the timeline necessary to complete new standards development, design, production, and installation of new radio altimeters for thousands of commercial aircraft. Many CAAs and Regional Safety Oversight Organizations continue to work together on their respective regional airspace interests but there needs to be an effort to continue to work on global standards.

Action: The Conference is invited to agree to Recommendation 4.1/x in Paragraph 3.

1. INTRODUCTION

1.1 The radio altimeter (RA) is an essential aviation safety system that measures aircraft height above terrain and obstacles in all phases of flight for tens of thousands of commercial aircraft as well as numerous business and general aviation aircraft. This height information is critical to support several navigation and safety functions such as terrain awareness, automatic landing, wind shear detection, aircraft collision avoidance, and other flight control systems. The RA operates in the frequency band 4.2 – 4.4 GHz, and without proper controls and mitigations, external transmissions within the RA frequency band or high-power transmissions in adjacent frequency bands may interfere with RA intended function and therefore pose a serious safety risk if not properly mitigated.

1.2 5G C-Band deployments continue across the world. The technical characteristics of the deployments vary State by State, but the safe coexistence with aviation operations and radio altimeters remains a concern. 5G C-Band and similar transmissions may interfere with radio altimeters with a high-power signal near the radio altimeter band, or with spurious emissions (e.g., emissions within the RA band emanating from the 5G transmitter) that interfere with the RA's ability to receive its own return signal.

1.3 5G C-Band is one example of a larger compatibility issue with dedicated aviation spectrum bands. Spectrum is a valuable and scarce resource, and it will require collaboration across multiple industries to ensure safe expansion with existing uses. Several States have implemented temporary mitigations on 5G systems to protect radio altimeters while RTCA and EUROCAE are working on updated minimum operational performance standards for the radio altimeter. While these agreements have been beneficial to both industries, they are not a durable solution.

2. DISCUSSION

2.1 There is high demand for new spectrum for mobile telecommunications, but States allocating new C-Band spectrum to accommodate this growth in demand must be aware of the potential risk to RA from transmissions in adjacent frequency bands and develop spectrum management policies that appropriately mitigate these aviation safety hazards. There is global interest in frequency ranges near the radio band though implementation to date has varied from State to State. A number of States have taken various approaches to addressing 5G C-Band radio altimeter interference. These include the promulgation of advisory material, the establishment of safety areas near airports to be protected from such interference, and the regulation of 5G C-band base station deployments in terms of authorized frequencies, allowed output power and antenna aiming.

2.2 U.S. registered commercial aircraft and foreign commercial aircraft that fly into the United States recently completed a retrofit to existing radio altimeters to ensure safe coexistence with 5G C-Band emissions in the United States under the conditions of a voluntary agreement with the wireless companies in the United States. The retrofit was a short-term mitigation to allow near-full deployment of wireless networks with minimum impact on aviation. Without this voluntary agreement by wireless companies in the United States to limit emissions into the radio altimeter band, even retrofitted aircraft would be subject to operational restrictions to ensure safe aviation operations. This voluntary agreement expires in January 2028 and aviation operations may be severely impacted in the United States unless a permanent solution for coexistence is found. Many States and telecom regulating agencies are developing coexistence strategies for their unique deployment characteristics.

2.3 RTCA and EUROCAE are working on updating the minimum operational performance standards for the radio altimeter. Their goal is to develop interference tolerance standards, using state-of-the-art avionics designs, to improve the robustness of future radio altimeters to existing and planned in-band and out-of-band interference; however, the new standards may not resolve all possible spurious and fundamental interference effects from transmissions near the RA band.

2.4 Safe aviation operations rely on sufficient separation between aircraft and transmitters in bands that are too close in frequency or which transmit excess spurious emissions into the radar altimeter band. Another challenge is the timeline necessary to complete new standards development, design, production, and installation of new radio altimeters for thousands of commercial aircraft. Many States and Regional Safety Oversight Organizations continue to work together on their respective regional airspace interests but there is also general agreement that there needs to be an effort to continue to work on global standards.

3. CONCLUSION

3.1 The United States recognizes the success of the global aviation community in working through ICAO to enhance global aviation safety and efficiency. However, the processes we collectively employ need to reflect the realities of a complex and changing spectrum ecosystem that is likely to impact aviation in the present and future. The wireless communications industry and other competitors for spectrum resources innovate quickly. There is a need to optimize ICAO's standards-development process to meet the realities of today and our expectations for the future while retaining the highest levels of safety that the public has come to expect from air transportation. This work is important to the continued effectiveness of ICAO as the forum for obtaining the highest practicable degree of uniformity and interoperability in civil aviation worldwide, and particularly with regard to those standards calling upon all sectors to converge in meeting a new operational condition.

3.2 ICAO and States need to continue to support RTCA/EUROCAE efforts to develop a global standard for the best achievable radio altimeter performance in the 4.2 – 4.4 GHz band. ICAO and States need to continue to collaborate with State spectrum regulators to ensure coexistence near the radio altimeter band, and take into account the performance of new state-of-the-art radio altimeters designed to the new RTCA/EUROCAE standards as plans are made for future 5G C-Band rollouts that coincide with realistic timelines for deployment of new radio altimeter equipment. Aviation safety during critical phases of flight at or near airports require adequate separation from transmitters that may interfere with the radio altimeter.

3.3 ICAO and States must continue to collaborate and cooperate, globally and regionally, along with the aviation and broadband/cellular industries to ensure that future allocations in frequency bands near (both above and below) the 4.2 – 4.4 GHz RA band are implemented appropriately and continue to ensure the safety of aviation operations.

3.4 The Conference is invited to:

- a) agree that better coordination is needed among States to minimize the chances of uncoordinated actions that could complicate future retrofits and compatibility;
- b) agree that ICAO should continue to develop and update guidance material to States on safeguarding radio altimeters from potential harmful interference from 5G C-band wireless communication and develop guidance to aircrews to operate safely in a potential radio altimeter inference environment; and
- c) agree that better coordination is needed among States to provide a consistent message to State spectrum regulators at all levels to provide expertise and data on the potential safety and related aviation economic impacts of spectrum allocation discussions and studies that may affect critical aviation frequencies.

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